We claim:

1. A microsensor for sensing a substance comprising:

a substrate;

a source of light;

an optical microresonator fabricated in the substrate exposed to the substance to allow an interaction between the microresonator and substance;

a waveguide coupling the source of light to the optical microresonator; and

a detector coupled to the microresonator to measure a performance parameter of the optical microresonator sensitive to interaction of the substance with the optical microresonator.

2. The microsensor of claim 1 further comprising a polymer coating disposed on the microresonator, which polymer coating is reactive with the substance.

3. The microsensor of claim 1 where the microresonator is a semiconductor optical ring microresonator.

4. The microsensor of claim 1 where the microresonator has an initial Q of 10,000 or greater.

5. The microsensor of claim 1 where the performance parameter is the resonant frequency of the microresonator.

6. The microsensor of claim 1 where the performance parameter is the absorption loss of whispering gallery modes in the microresonator.

7. The microsensor of claim 1 where the performance parameter is the quality factor of the microresonator.

8. The microsensor of claim 1 where the detector is a germanium detector and the substrate is a silicon-on-insulator (SOI) heterostructure.

9. The microsensor of claim 8 further comprising CMOS integrated read-out circuitry fabricated in the substrate and coupled to the germanium detector.

10. The microsensor of claim 1 where the detector comprises a read-out optic fiber coupled to a grating coupler.

11. The microsensor of claim 1 further comprising a plurality of microresonators and a corresponding plurality of detectors formed into an array coupled by the waveguide to the light source in which the plurality of microresonators are exposed to a plurality of substances.

12. The microsensor of claim 11 further comprising an addressing circuit for reading the array.

13. The microsensor of claim 12 further comprising CMOS integrated read-out circuitry fabricated in the substrate coupled to the addressing circuit.

14. The microsensor of claim 1 where the detector comprises a polycrystalline germanium detector fabricated proximate to the microresonator.

15. The microsensor of claim 1 where the detector is deposited onto the waveguide during a post-processing step following CMOS fabrication of the waveguide.

16. The microsensor of claim 1 further comprising a microfluidic circuit for communicating the substance to the microresonator.

17. The microsensor of claim 16 where the microfluidic circuit comprises pneumatic valves and peristaltic pumps defined by multi-layer replication lithography for delivering picoliter volumes of the substance to the microresonator.

18. The microsensor of claim 1 where the microresonator is characterized by an optical absorption loss determined by direct optical excitation of the substance when in contact with the microresonator.

19. The microsensor of claim 18 further comprising a plurality of microresonators corresponding to a plurality of different resonant frequencies to generate an absorption spectrum of the substance.

20. The microsensor of claim 2 where the coating reacts with the substance to form an altered optical parameter which in turn alters an optical parameter of the microresonator.

21. The microsensor of claim 20 where the altered optical parameter is the refractive index of the coating or the waveguide loss of the microresonator.

22. The microsensor of claim 20 where the coating reacts only with the substance.

23. The microsensor of claim 22 where the coating is reacts only with the substance by means of an enzyme linked immunosorbent assay (ELISA).

24. The microsensor of claim 2 further comprising a microfountain pen and where the coating is applied to the microresonator by the microfountain pen.

25. The microsensor of claim 2 further comprising an elastomeric flow channel in communication with the microresonator and where the coating is applied to the microresonator by a functionalization treatment by means of the elastomeric flow channel.

26. The microsensor of claim 1 further comprising a plurality of microsensors organized in an addressable array on the substrate, ones of the plurality of microsensors being resonant at or tuned to different optical frequencies, absorption losses of the plurality of microsensors being measured as a result of optical coupling between an analyte and ones of the resonators as determined by the resonant frequency of the microresonator and the absorption peak of the analyte, whereby an absorption spectrum of direct spectroscopy of an analyte or absorption of antibody-linked fluorescent molecules used as markers are measured.

27. The microsensor of claim 1 further comprising a plurality of microsensors organized in an addressable array on the substrate, the plurality of corresponding resonators having a selectively pretreated surface, a change in refractive index or waveguide loss of ones of the plurality of resonators arising as a result of selective attachment of an analyte to the pretreated surface being measured.

28. The microsensor of claim 1 where the substrate is a silicon-on-insulator (SOI) substrate, where the waveguide and microresonator are fabricated on the substrate by means of SOI processes and where the detector is fabricated on the substrate by means of CMOS fabrication processes.

29. The microsensor of claim 1 where the source of light comprises an external laser.

30. The microsensor of claim 1 where the source of light comprises a filtered tungsten filament lamp, a filtered broad-band light emitting diode, a Fabry-Perot cleaved cavity laser, a vertical cavity surface emitting (VeSEL), or a grating coupled surface emitting laser directly bonded onto the substrate.

31. The microsensor of claim 13 where the CMOS integrated read-out circuitry provides diagnostic information on the condition of sensor performance and electronic intelligence in the read-out process.

32. The microsensor of claim 31 further comprising a wireless interface fabricated on the substrate and communicated to the read-out circuitry.

33. A method for sensing a substance comprising:

providing a substrate;

providing a source of light;

communicating the light through a waveguide coupled to the source of light to an optical microresonator fabricated in the substrate exposed to the substance to allow an interaction between the microresonator and substance; and

detecting the interaction between the microresonator and substance by measurement of a performance parameter of the optical microresonator.

34. The method of claim 33 further comprising disposing a polymer coating on the microresonator, which polymer coating is selectively reactive with the substance.

35. The method of claim 33 where detecting the interaction between the microresonator and substance comprising detecting the optical performance of a semiconductor optical ring microresonator.

36. The method of claim 35 where detecting the optical performance of a semiconductor optical ring microresonator comprises measuring the optical performance of a microresonator with an initial Q of 10,000 or greater.

37. The method of claim 36 where measuring the optical performance of a microresonator comprises measuring the resonant frequency of the microresonator.

38. The method of claim 36 where measuring the optical performance of a microresonator comprises measuring the absorption loss of whispering gallery modes in the microresonator.

39. The method of claim 36 where measuring the optical performance of a microresonator comprises measuring the quality factor of the microresonator.

40. The method of claim 33 where detecting the interaction between the microresonator and substance comprises detecting the optical output of the microresonator with a germanium detector and where providing the substrate comprises providing a silicon-on-insulator (SOI) heterostructure.

41. The method of claim 33 further comprising fabricating CMOS integrated read-out circuitry in the substrate corresponding to each microresonator.

42. The method of claim 33 where detecting the interaction between the microresonator and substance comprises coupling light from the microresonator to a read-out optic fiber coupled to a grating coupler.

43. The method of claim 33 further comprising providing a plurality of microresonators and a corresponding plurality of detectors configured into an array coupled by the waveguide to the light source and exposing the plurality of microresonators to the substance or plurality of substances.

44. The method of claim 43 further comprising fabricating an addressing circuit on the substrate for reading the array.

45. The method of claim 44 further comprising fabricating CMOS integrated read-out circuitry in the substrate coupled to the addressing circuit.

46. The method of claim 33 where detecting the interaction between the microresonator and substance comprises detecting the interaction with a polycrystalline germanium detector fabricated proximate to the microresonator.

47. The method of claim 46 further comprising fabricating the waveguide with CMOS processes and fabricating the detector in communication with the waveguide during a post-processing step following CMOS fabrication of the waveguide.

48. The method of claim 33 further comprising providing a microfluidic circuit for communicating the substance to the microresonator.

49. The method of claim 48 where providing a microfluidic circuit comprises fabricating pneumatic valves and peristaltic pumps by multi-layer replication lithography for delivering picoliter volumes of the substance to the microresonator.

50. The method of claim 33 where detecting the interaction between the microresonator and substance comprises measuring an optical absorption loss of the microresonator arising from direct optical excitation of the substance when in contact with the microresonator.

51. The method of claim 50 further comprising detecting the interaction between the microresonator and substance at a plurality of microresonators corresponding to a plurality of different resonant frequencies to generate an absorption spectrum of the substance.

52. The method of claim 34 further comprising selectively reacting the coating with the substance to alter an optical parameter of the microresonator.

53. The method of claim 52 where reacting the coating with the substance comprise altering the refractive index of the coating or the waveguide loss of the microresonator.

54. The method of claim 52 where selectively reacting the coating with the substance comprises reacting only with the substance.

55. The method of claim 54 where reacting only with the substance comprises reacting only with the substance by means of an enzyme linked immunosorbent assay (ELISA).

56. The method of claim 34 further comprising applying the coating to the microresonator by means of a microfountain pen.

57. The method of claim 34 further comprising applying the coating to the microresonator by means of an elastomeric flow channel in communication with the microresonator.

58. The method of claim 33 further comprising providing a plurality of microsensors organized in an addressable array on the substrate, ones of the plurality of microsensors being resonant at or tuned to different optical frequencies, measuring the absorption losses of the plurality of microsensors as a result of optical coupling between an analyte and ones of the resonators as determined by the resonant frequency of the microresonator and the absorption peak of the analyte, and generating an absorption spectrum of direct

spectroscopy of an analyte or absorption of antibody-linked fluorescent molecules used as markers are measured.

59. The method of claim 33 further comprising providing a plurality of microsensors organized in an addressable array on the substrate, the plurality of corresponding resonators having a selectively pretreated surface, changing the refractive index or waveguide loss of ones of the plurality of resonators as a result of selective attachment of an analyte to the pretreated surface and measuring the change the refractive index or waveguide loss to generate an assay of the substance.

60. The method of claim 33 where providing the substrate provides a silicon-on-insulator (SOI) substrate, and further comprising fabricating the waveguide and microresonator on the substrate by means of SOI processes and fabricating the detector on the substrate by means of CMOS fabrication processes.

61. The method of claim 33 where providing the source of light comprises providing an external laser.

62. The method of claim 33 where providing the source of light comprises providing a filtered tungsten filament lamp, a filtered broad-band light emitting diode, a Fabry-Perot cleaved cavity laser, a vertical cavity surface emitting

(VeSEL), or a grating coupled surface emitting laser directly bonded onto the substrate.

63. The method of claim 45 further comprising generating diagnostic information on the condition of sensor performance and electronic intelligence by means of the integrated read-out circuitry.

64. The method of claim 45 further comprising fabricating a wireless interface on the substrate communicated to the read-out circuitry.